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THE RESPONSE OF DIFFERENT VARIETIES OF POTATOES TO DIFFERENT AMOUNTS OF COPPER IN A MODIFIED SPRAY PROGRAM

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In previous publications (2, 4, 5 and 6) it has been shown that with Smooth and Russet Rural potatoes grown near Pittsford in western New York, and in the absence of late blight, maximum yields were obtained by applying about 75 pounds of copper sulfate per acre during the season in the form of bordeaux mixture. In these experiments the spray was applied at a pressure of 400 pounds and the concentration of the mixture was uniform throughout the season, that is, a 5-5-50 mixture. It was also shown that further increases in yield could be obtained by varying the concentrations so as to apply the larger part of the copper early in the season. Additional experiments (3) showed increases in yield by lowering the lime content of the mixture and also that with such low lime mixtures smaller amounts of copper were required to give maximum yields.

As a next step in this series of experiments, it seemed desirable to combine all the above modifications in one spraying schedule, varying only the amount of copper applied, in order to determine the optimum amount of copper sulfate to be applied in such modified schedules. At the same time, arrangements were made to include two other standard varieties of potatoes by having the field planted in strips of the varieties in a manner so that the field could be divided into blocks which included strips of each variety of potatoes sprayed with each different schedule. This comparison of the response of varieties was considered particularly desirable since the same spraying schedules applied in different parts of the state have given different results. At these different places, there were variations in varieties of potatoes, soil and climatic conditions as well as in insect pests and diseases. By growing all the varieties in one field, the response of the varieties could be compared at least under one set of conditions.

As the concentrations were changed for each application in each schedule, the formulae are given in detail, as follows:

Application Schedules

Application	Unsprayed 0	Schedule Numbers		
		1	2	3
1st	0	3.6–1.8 –50	4.8–2.4–50	6.0–3.0 –50
2nd	0	6.0–3.0 –50	8.0–4.0–50	10.0–5.0 –50
3rd	0	4.8–2.4 –50	6.4–3.2–50	8.0–4.0 –50
4th	0	3.6–1.8 –50	4.8–2.4–50	6.0–3.0 –50
5th	0	2.7–1.35–50	3.6–1.8–50	4.5–2.25–50
6th	0	1.8–0.9 –50	2.4–1.2–50	3.0–1.5 –50
Total amount of Copper Sulfate applied per acre during the season in pounds				
	0.0	45.0	60.0	75.0

Schedule Number 3 is essentially the same as that suggested by the authors for general trial and recommended by Barrus and Crosby (1) for use in up-state New York. The other schedules are based on schedule 3, but the concentration of materials was reduced proportionally to give a graduation of totals for each application and for the season. Four hundred pounds pressure was used throughout the experiment. The three varieties used were Irish Cobbler, Green Mountain and Rural Russet. The date of planting was June 18, 1934.

One measure of the comparative size of the plants was the counting of the total leaflets per plant (figure 1) from which it appears that the more copper was applied, the larger were the plants, from the first of August throughout the remainder of the season for each of the three varieties. The number of leaves varied on different varieties and the maximum growth was reached earlier with the Irish Cobblers than with the Rural Russets and Green Mountains.

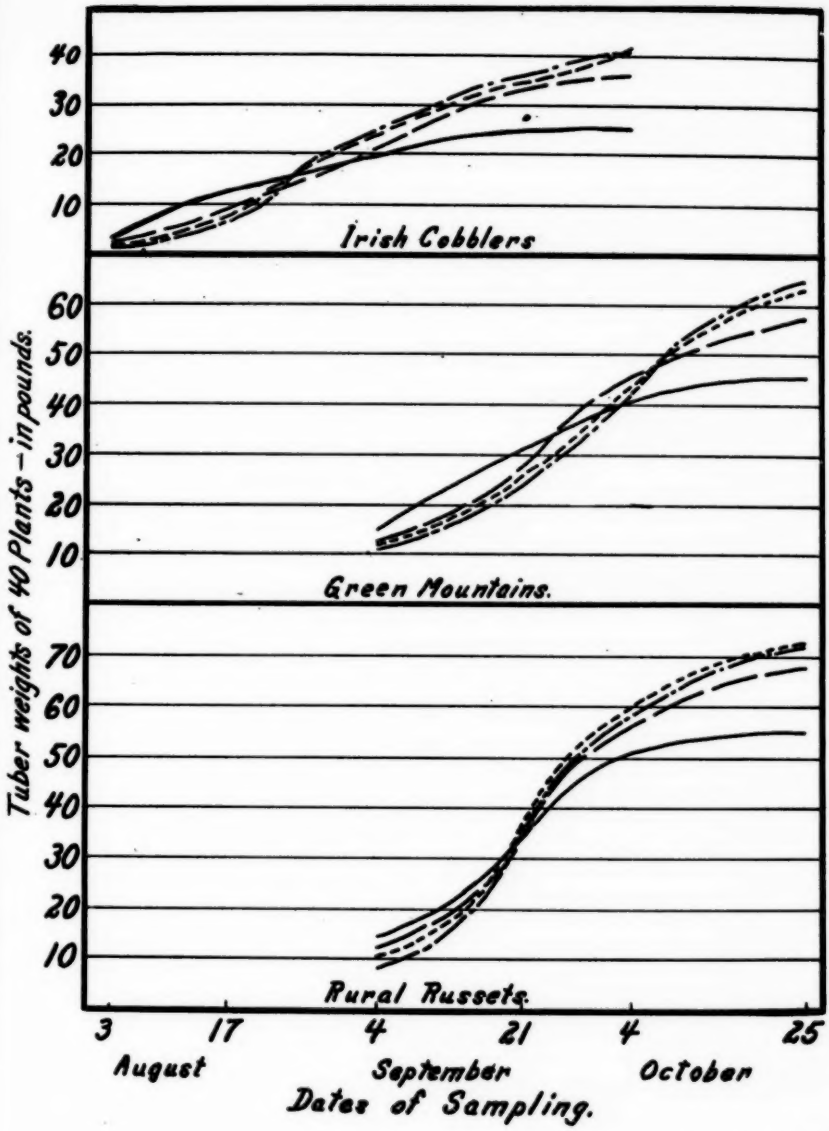

FIGURE 1.—*Showing the effect of spraying with bordeaux mixture on the total number of leaflets per plant and the number of tipburned leaflets at different dates during the summer. A. Total leaflets, B. Tipburned leaflets;* ———— *Unsprayed,* —— —— *Treatment No. 1,* – – – – *Treatment No. 2,* —— - —— - —— *Treatment No. 3.*

At the same time, tipburn appeared first and increased most rapidly on the Cobblers. The unsprayed Cobblers had few healthy leaflets by September 11, with a gradation to the largest number of healthy leaflets on the vines which had received the largest amount of copper. In this experiment, as in some previously reported (4, 5 and 6), the differences in the total number of leaflets on plants of different treatments developed earlier and were larger than differences in numbers of tip-burned leaflets, thus indicating that differences in size of plants as measured by the total number of leaflets took place quite independently of the tipburn injuries. The unsprayed Green Mountains and Rural Russets had developed considerable tipburn by October 2, but even at that date the differences in numbers of tipburned leaflets on the Rurals sprayed with different amounts of copper were very small and probably not significant, though considerable differences were evident in the total number of leaflets.

Plants from the different treatments and varieties were dug at intervals during the season in order to study the effect of the copper on foliage and tuber development. Ten plants per unit were selected and dug in four comparable places so as to give a total of forty plants per date of digging for each treatment and variety.

The results which are given in table 1 show clearly that there is an agreement between the total green weights and the total number of leaflets per plant. It was found for each of the three varieties that the larger the amounts of copper applied, the higher were the green weights.

The situation as regards tuber weights was different, but similar to that reported in other experiments (4, 5 and 6). Tuber development early in the season was most rapid on the unsprayed plants of all three varieties. A study of the graphs (figure 2) showing the weights of tubers from forty plants of each variety for each treatment at the various digging dates, shows that the sprayed plants of all varieties finally caught up with the unsprayed in total weight of tubers, but there was considerable difference in the dates at which this occurred. The unsprayed Cobblers still yielded more than the sprayed on August 17 or 60 days after the planting date. For the Rural Russets, this was true until September 4, or 78 days after planting; but for the Green Mountains, the unsprayed yielded highest until September 21, or 95 days after planting. This prolonged delay in tuber enlargement on sprayed Green Mountains may explain in part at least, why losses, instead of increases in yield are so frequently obtained by spraying

TABLE 1.—*Foliage and tuber weights of the various treatments harvested at intervals during the season.*

Total of 40 plants each.

Date of Sampling	Unsprayed	Treatment Number 1	2	3
VARIETY: IRISH COBBLERS				
	Foliage weights in pounds			
July 24	12.50	13.5	13.63	13.73
Aug. 3	19.63	20.38	23.63	24.88
Aug. 17	20.50	22.38	25.13	26.13
Sept. 4	19.63	21.25	23.38	25.25
	Tuber weights in pounds			
Aug. 3	2.75	2.00	1.88	1.75
Aug. 17	12.00	9.88	8.38	7.88
Sept. 4	19.63	21.25	23.38	24.25
Sept. 21	24.00	33.00	33.38	34.13
Oct. 4	24.50	36.38	41.13	40.50
VARIETY: GREEN MOUNTAIN				
Date of Sampling	Unsprayed	Treatment Number 1	2	3
	Foliage weights in pounds			
July 24	10.38	12.00	12.13	12.75
Aug. 3	20.38	23.00	26.00	26.38
Aug. 17	24.88	27.50	28.38	29.75
Sept. 4	36.13	40.50	43.13	44.63
Sept. 21	37.75	43.88	46.25	47.75
	Tuber weights in pounds			
Sept. 4	15.00	12.50	11.25	10.88
Sept. 21	30.75	28.63	27.00	26.88
Oct. 4	40.50	45.75	44.00	43.75
Oct. 25	46.00	57.63	63.38	65.00
VARIETY: RURAL RUSSETS				
Date of Sampling	Unsprayed	Treatment Number 1	2	3
	Foliage weights in pounds			
July 24	10.25	11.25	11.75	12.75
Aug. 3	16.38	20.63	23.50	24.38
Aug. 17	20.50	25.25	26.75	28.88
Sept. 4	33.50	40.63	42.50	44.50
Sept. 21	36.25	44.25	47.75	50.25
	Tuber weights in pounds			
Sept. 4	14.00	11.50	10.13	8.13
Sept. 21	34.25	35.50	36.88	35.50
Oct. 4	50.73	56.00	59.75	59.00
Oct. 25	55.00	67.75	72.75	71.25

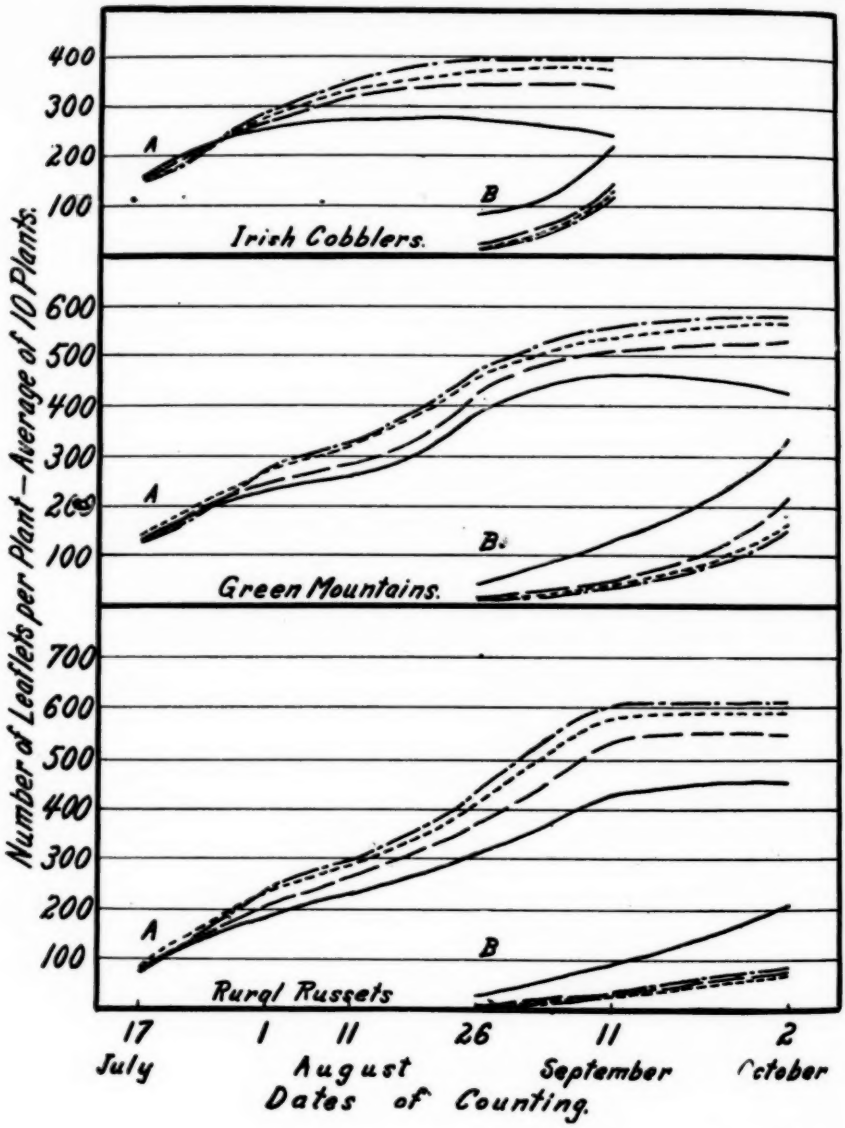

FIGURE 2.—*Showing the course of tuber development with the three varieties, Irish Cobbler, Green Mountain and Rural Russet, unsprayed and when sprayed with 3 amounts of copper sulfate per acre during the season in the form of bordeaux mixture.* ———— *Unsprayed,* —— —— *Treatment No. 1,* - - - - *Treatment No. 2,* —— - —— - *Treatment No. 3.*

TABLE 2.—*Numbers of tubers, weight of tubers per hill, and average weight per tuber in the variety concentration experiment*

1934

Date of Sampling	Irish Cobblers				Green Mountains				Rural Russets			
	Treatment Number				Treatment Number				Treatment Number			
	0	1	2	3	0	1	2	3	0	1	2	3
	Number of tubers per hill—(Average of 40 hills)											
Aug. 17	6.8	6.4	5.8	5.8								
Sept. 4	3.5	4.7	4.9	5.0	6.7	6.7	8.0	8.2	7.1	8.1	8.5	10.0
Sept. 21	2.9	3.3	3.7	3.6	6.5	6.8	7.2	7.8	4.5	6.0	6.3	6.4
Oct. 4	2.9	3.3	3.7	3.6	6.3	6.8	7.4	8.3	4.3	5.5	5.8	6.1
Oct. 15					5.4	6.3	7.6	7.8	4.3	5.4	5.5	5.7
	Number weight per hill in pounds (Average of 40 hills)											
Aug. 17	0.300	0.247	0.210	0.197								
Sept. 4	0.491	0.531	0.585	0.606	0.375	0.313	0.281	0.272	0.350	0.288	0.253	0.203
Sept. 21	0.600	0.825	0.835	0.853	0.769	0.716	0.675	0.672	0.856	0.888	0.922	0.888
Oct. 4	0.613	0.910	1.028	1.013	1.013	1.144	1.100	1.094	1.268	1.400	1.494	1.475
Oct. 25					1.150	1.441	1.585	1.625	1.375	1.694	1.819	1.781
	Average weight per tuber in pounds											
Aug. 17	0.044	0.039	0.036	0.034								
Sept. 4	0.140	0.113	0.119	0.121	0.056	0.047	0.035	0.033	0.049	0.036	0.030	0.020
Sept. 21	0.207	0.250	0.226	0.327	0.118	0.105	0.094	0.086	0.190	0.148	0.146	0.139
Oct. 4	0.211	0.276	0.278	0.281	0.161	0.168	0.149	0.132	0.295	0.255	0.258	0.242
Oct. 25					0.213	0.229	0.209	0.208	0.320	0.314	0.331	0.312

this variety, particularly if extremely hot dry weather occurs early in the growing season as it has regularly in some localities.

Data obtained from this experiment but which cannot be included here conveniently also showed that the carbon nitrogen ratio throughout the season was markedly affected by the copper treatments as compared with the unsprayed for all varieties.

The number of tubers per hill in the different treatments was recorded at each digging date throughout the season (table 2) and the most striking phenomenon was a general decrease in the number of tubers per hill as the season advanced in all treatments and varieties. The largest drop in numbers occurred on unsprayed plants. Thus one important effect of spraying, which has been found also in other experiments (4 and 5) is that it causes the retention and development of a larger number of tubers in each of these varieties.

If the other parts of table 2, giving weight of tubers per hill and average weight per tuber are studied closely, it will be evident that most of the increased yield from spraying is due to the larger number of tubers per hill. Only in the Cobblers was the average weight per tuber consistently more for the sprayed plants.

Tubers of the Rural variety from the unsprayed plots and those receiving schedule 3 were sorted for scab on October 10, and it was found that the sprayed plants of schedule number 3 yielded 4.4 per cent scabby tubers, while the unsprayed plants gave 38.8 per cent as reported with other results in a previous article in this Journal (7). It will be observed that the tubers on the unsprayed plants averaged about two and one-half times as large as those on the sprayed plants on September 4, the first date of sampling.

Final yields were taken on nine plots of one-hundredth acre each on the unsprayed, and from fifteen such plots for each spray treatment of each variety (table 3). From table 3 and the analysis of variance appended it may be concluded:

(1) That the rather striking differences in yields due to varieties were so consistent as to be statistically highly significant.

(2) That the spray treatments also caused highly significant differences in yields.

(3) That most of this difference, as might be expected was between the sprayed and unsprayed.

(4) That there was no significant difference between the plots sprayed with 60 pounds of copper sulfate per acre during the season and those sprayed with 75 pounds.

(5) That the plots receiving 45 pounds of copper sulfate per

TABLE 3.—*Final yields in bushels per acre*

Amount of Copper Sulfate Applied per Acre During the Season	Variety			
	Irish Cobblers	Green Mountains	Rural Russet	Average
Unsprayed	115.1*	203.2*	225.4*	181.2
45 Pounds	170.8**	263.6**	287.7**	240.7
60 Pounds	184.2**	286.1**	307.2**	259.1
75 Pounds	188.4**	289.2**	301.5**	259.7
	164.6	260.5	280.5	235.2

* Averages of 9 plots each. ** Averages of 15 plots each.

ANALYSES OF VARIANCE

	Degrees of Freedom	Sum of Squares	Mean Squares	Treatment / Error	** All differences significant and giving odds greater than 100:1 that they are not due to chance.
Total	161	565,050.2842	3,509.6291		
Varieties	2	419,522.0868	209,761.0434		
Treatments	3	127,112.7466	42,370.9155	1,776.92**	
Error	156	18,415.4508	118.0478	358.93**	
Sprayed vs. unsprayed	1	116,587.2060	116,587.2060	987.63**	
Amounts copper	2	10,525.5406	5,262.7703	44.58**	
Varieties sprayed	2	358,723.4584			
Varieties x amounts	4	870.5563	217.6391	1.84	
60 + 75 lbs. copper sulphate	1	7.3960	7.396	.06	

acre during the season yielded about 20 bushels per acre less than the other sprayed plots on the average; a highly significant difference.

(6) That in final yields, the different varieties did not give any significantly different response to the spray treatments.

SUMMARY

Working with the Irish Cobbler, Rural Russet and Green Mountain varieties of potatoes at Pittsford, N. Y., it was found that all these varieties respond to copper treatments in the form of bordeaux mixture to approximately the same extent in final increases in yields. Using a Bordeaux mixture composed of the equivalent of half as much quick lime as copper sulfate, and applying most of the copper early in the season, there appeared to be no advantage in using more than a total of 60 pounds of copper sulfate per acre during the season.

All copper-sprayed plants retained more tubers per plant than unsprayed plants of the same variety.

All varieties showed evidence of a retardation in tuber development due to spraying. The retardation was less pronounced with the Cobblers and most pronounced with the Green Mountains. In the Green Mountains, the unsprayed plants yielded more than the sprayed until after September 21.

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A STUDY OF CULINARY QUALITY IN WHITE POTATOES*

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Quality in any crop plant is somewhat difficult to determine because of the large number of characteristics involved and the lack of a standard measurement. Potatoes are especially difficult to judge since human tastes vary and particularly since different people have varying conceptions of what constitutes good and poor quality in potatoes. Even after a standard has been established the degree of good or bad quality will vary with the human element involved. However it has been assumed for the purposes of the work described in this paper, that the standard of quality and the method of judging are suitable for the material involved.

There are two conceptions of quality. The first is that the best quality potato is one which cooks with a white, dry, mealy consistency. The second is that the cooked tuber should be firm and waxy or soggy. The former is the more popular conception of good quality in potatoes.

There is a rather general disagreement as to just what structure and composition of the tuber is associated good and poor quality. It is likewise true that the environmental factors which have an important influence on quality are not clearly understood.

East (1) states that in France sogginess is desirable, since the accepted method of cooking is deep fat frying, for which a tuber able to hold its form is desired. In the United States the larger part of the consumption is in the form of boiled or baked potatoes, which are desired dry and mealy.

Gavin (2) writes that a dry flour-like potato is best for the English householder though a more solid waxy potato is better for making potato chips. Coudon and Bussard (3) in 1897 considered that the best tubers for cooking were those which retained their form and remained firm and soggy after cooking, and those poor for cooking

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which broke down and became mealy after boiling. Langworthy (4) writes that in this country the chief test of excellence is mealiness. Goldthwaite (5) gives an opinion similar to Langworthy.

A rather common conception of the reason for mealiness is that a large supply of starch grains within the cells swell upon cooking and burst the cell walls giving a white flaky appearance. The opposite condition of sogginess would naturally follow as the result of an insufficient supply of starch grains and a higher proportion of water. These suggestions are supported by Gilmore (6) and East (1).

Recent work has thrown some doubt on the above explanation. Day (7) has shown that starch grains do not swell sufficiently to burst the cell walls of a cooked tuber. Sweetman (8) supports this and says that the cell walls do not burst but readily separate as an effect of the heat of cooking, and that this cell separation is accompanied by other physico-chemical changes. Yet this latter work does not prove that mealiness is not accompanied by a large amount of starch in the tuber. Butler (9) claims that cell separation rather than a bursting of the cells, gives the mealy consistency to a cooked potato. Whether the starch grains swell and burst the cell walls or not, the question still remains as to whether or not good quality is associated with a larger amount of starch and less nitrogen. The writer's observations agree with those of East (1) and others that those parts of the tuber having the greatest concentration of starch grains within the cells cook up the mealiest. Thus the cortex, external medullary and internal medullary rank in descending order.

There is a difference of opinion as to the effect of total amount of starch and protein or nitrogen in the tuber. Ashby (10), East (1), Langworthy (4), Headden (11), Willaman & West (12), Squirrell and MacLennan (13) contend that high starch and dry matter and low protein are directly correlated with good quality or mealiness. Gilmore (6) agrees with the above workers, although he claims that an even distribution of external and internal medullary is more important than composition. Coudon and Bussard (3) give a similar correlation but the opposite interpretation of quality. Some of those who contend that there is no correlation between starch and dry matter and quality are; Butler, Morrison & Boll (8), Neil & Whittemore (14).

A survey of the literature reveals somewhat differing opinions as to the effect of growing conditions on quality. East (1) considers the soil more important than climate and states that any factor leading to better growing conditions, such as sand, or gravel, fertilizer, and adapted variety, is conducive to good quality. Hardenburg (15) ob-

tained better quality tubers from muck soil than from mineral types and better from sandy than from silty types. Squirrell and MacLennan (12) claim that the variety influences quality more than any other factor. Findlay (16) writes that the four most important influences on quality are variety, kind of soil and season, fertilizers and maturity. He found that tubers grown in clay soil were distinctly poorer than from other types of soil. Houghland and Schricker (17) found no increase in starch content and dry matter from applications of potash fertilizer while Neil & Whittemore (13) found the opposite to be true. Goldthwaite (5) thinks that quality in potatoes depends more upon the grower, soil, and season than upon variety. Neil and Whittemore (13) found that potatoes were less mealy when grown with insufficient potash than when an abundance was supplied. Headden (10) showed an injurious effect on quality from use of excessive amounts of nitrogenous fertilizers. Eckenbrecher (18) shows that disease reduces starch content. Plants showing 7.7 per cent disease produced tubers with 17.7 per cent starch, those showing 0.05 per cent disease produced tubers containing 20.6 per cent starch.

Smith (19) says that in the United States the potato has made its greatest development in the cooler sections of the country where the mean temperature in July is not over 70°F. Stuart (20) states that high air and soil temperatures are incompatible with a healthy and normal growth of the potato plant, and if high temperatures prevail at tuber setting time then the yield will be reduced and tubers visibly modified. He also says that the presence of a sufficient amount of soil moisture exercises a favorable influence on soil temperature during hot periods of air temperature.

Werner (21) and Pieper, Burlison and Flint (22) show that mulching improves the quality of potatoes. One of the chief benefits claimed for mulching is that of maintaining a lower soil temperature.

The first year of this experiment, 1929, one hundred peck lots of potatoes were collected from different parts of the state. Some came from farmers' fields and some from fertilizer trial plots. A blank form sheet was filled out for each lot giving in detail the growing conditions during the season. This information sheet was also used during all subsequent years of the experiment.

For the years following 1929 it was decided to obtain lots from more controlled conditions. One bushel of disease free seed of each of four different strains of late potatoes was obtained. From each of the four bushels five tubers were planted as tuber units in various parts of the state. These were planted in the fields of good potato

growers so that all four strains would have the same growing conditions. Under normal seasonal conditions at least a peck of average size tubers was obtained from the twenty hills. This gave a comparison of strains under the same growing conditions and of all strains under different growing conditions. In the year 1930, fifty-two lots were harvested; in 1931, one hundred and thirteen; in 1932, seventy-five; and in 1933, fifty-six.

Method of Cooking and Quality Judging

All samples of tubers were cooked by boiling and baking and were judged accordingly. Four lots were tested each half day so that the ordeal of tasting did not become confusing to the taste. The same three men and three women acted as judges or scorers throughout the testing of each year's samples. Such close agreement was obtained on the scoring that no attempt has been made at statistical analysis.

Boiling—Three tubers from each lot were selected so that they were as nearly the same size as possible. They were washed and dried and any noticeably bad spots removed. The potatoes were weighed to aid in determining the length of time required for cooking, and also to determine any loss in weight. It was found, however, that the shape of the potato rather than the size, seemed to be the determining factor in time of cooking, round tubers required more time than flat ones of the same weight. The cooking was on a gas stove in kettles of uniform size in 2000 cc. of boiling hot water and the gas was regulated. The potatoes were considered cooked when they seemed soft to the cook by thrusting a paring knife into them.

The water was drained off and the potatoes judged immediately for flavor, texture and color.

Baking—Three tubers of approximately the same size were selected from each lot. These potatoes were washed, dried and weighed. They were then placed in the center of a gas oven with the thermostat set at 475° F. The potatoes were considered to be baked when they felt soft to a slight pressure of the hand. When cooked, they were pierced with a fork to allow the steam to escape. Shape was more important than weight in determining the time necessary for baking, a flat tuber baked more rapidly than a round one.

The score card used was one adapted from Child and Willaman (23). This seems to be simple to understand and use and yet detailed enough to give accurate numerical expression of degree of excellence for flavor, texture and color. The same card was used for boiled and baked potatoes. Fig. 1 shows the arrangement of the card. This gives

a perfect score of only twelve which is advantageous in avoiding the use of large figures. The same standard for each of the three characteristics was agreed upon by all judges during preliminary work so that the only error is due to slight individual variations from the standard.

FIG. I. POTATO CULINARY SCORE CARD

Sample No. 5					Score
Flavor	Strong 1	Slightly strong 2	Flat 3	Distinctive potato flavor 4	2.5
Interior Color	Very dark 1	Dark 2	Gray Yellow or pink 3	White or cream 4	3.1
Texture	Very soggy 1	Soggy 2	Slightly mealy 3	Mealy 4	2.8
Stem end browning	1				8.4
Hollowness	1 tuber hollow				

A score card might almost be workable with only one of the three characteristics since they seem to be quite well correlated. That is, a tuber with white cooked flesh generally is mealy and of good flavor. However, some exceptions to this make it desirable to score on the basis of all three. This agrees with the data and conclusions of Child & Willaman (22).

Note was made of stem end browning and hollowness in case these conditions should appear.

The breaking or sloughing off of the cortical layer was not allowed to influence the score because it seemed to be only the result of extra mealy quality and can be taken care of by proper method of cooking.

Method of Analysis

In 1929 one hundred, and in 1930 fifty-two lots of tubers were cooked and analyzed. No chemical analysis was made of the lots in subsequent years.

About ten medium-sized tubers weighing from 1,000 to 1,500 grams were selected for analysis of each lot. These tubers were thoroughly scrubbed with a brush in water, dried and then sliced with a paring knife into thin slices. This slicing was done directly into shallow glass platters and these platters were placed in a forced air draft electric oven. The temperature was maintained at 65° C. which gave little discoloration. About twelve hours were required with two stirrings, to get the slices dry and crisp so as to grind readily. The grinding was done in a Wiley Mill and the ground material placed in tightly-sealed jars properly labeled. Weighings were made to determine the loss of moisture.

Total nitrogen was determined by the official Kjeldahl method as given in the bulletin of A. O. A. C. The total nitrogen is considered as mostly protein in nature.

Total carbohydrates, considered as mostly starch were determined by official methods with slight modifications.

Results and Discussion

Observations were made on some external tuber characteristics as related to quality. Small ill-shaped, or immature tubers were observed to have poor quality. However the condition of the skin of well-shaped tubers did not seem to be a reliable index. Some darker or netted skinned tubers gave good or poor quality, while the same extremes were observed in the case of some light colored smoother skinned potatoes.

The number and depth of eyes seem to have little bearing on quality within the same variety. The number of eyes is largely a variety characteristic although within the variety there is a wide variation in number. It is true however, that a variety with a large number of eyes is not desirable either from a paring or cooking standpoint.

Table No. 1 shows a definite tendency for baked potatoes to give higher quality scores than boiled ones of the same lot. This seems to substantiate the claim that a higher proportion of starch to water within

the tuber gives better quality. Baking drives off some water while boiling does not. A large number of tests showed a 25 per cent loss of weight due to loss of water during baking of tubers while boiling gave no loss or gain of weight.

TABLE 1.—*Comparison of scores of boiled and baked samples of same lots.*

Year	No. Lots	Boiled	Baked	Odds
1929	100	10.12	10.90	$499(10)^6$:1
1930	53	9.55	10.00	35.0:1
1931	113	9.16	10.00	$391(10)^9$:1
1932	75	7.30	8.30	$499(10)^6$:1
1933	56	8.30	9.10	12,786.0:1

The odds show that each year's tests were strongly against so great a difference being due to chance alone.

These were obtained by computing the standard error of the difference and getting the ratio to the difference. Then the corresponding odds were found in Pearson's probability tables from Livermore's laboratory manual of biometry.

Table 2 shows the correlation table distribution of the relation between starch content and quality. The coefficient of correlation .247,±.051 is not sufficiently large to give a strong correlation between high starch content and mealiness or good cooking quality, yet it shows a tendency in that direction. If just the high and low quality lots are considered there is seen a strong relationship between high starch content and mealiness. This is shown in table 5.

TABLE 2.

CORRELATION OF QUALITY SCORE AND % STARCH

% STARCH \ QUALITY SCORE	11.71 12.00	11.41 11.70	11.11 11.40	10.81 11.10	10.51 10.80	10.21 10.50	9.91 10.20	9.61 9.90	9.31 9.60	9.01 9.30	8.71 9.00	8.41 8.70	8.11 8.40	7.81 8.10	7.51 7.80	7.21 7.50	f¹
8225-8101			1	1													2
8100-7976	1	1	1														3
7975-7851	1			1		1	1										4
7850-7726	1		1	1	1			2				1					7
7725-7601					1		1		1		1	1					5
7600-7476			2	1	2	2		1		1						1	10
7475-7351	2	2	3	4	1	3	1	3	1		1	1					22
7350-7226		1	2	3	5	2	3	1	4		2						23
7225-7101		1	3	1		3	4	1	1	3	1						18
7100-6976	1		1	2	2	7	3	5	2		1		1				25
6975-6851			1	1	1	3		1	4	4			1				16
6850-6726			1	1		2		1	1			2					8
6725-6601					2			2		1							5
6600-6476					1	1											2
6475-6351													(r=.247±.051)				0
6350-6226					1					1							2
f²	6	5	16	16	17	24	13	17	14	10	6	5	2	0	0	1	152

Table 3 shows a fairly good negative correlation between high nitrogen per cent and high quality. A coefficient of —.33±.048 is fairly significant. This is also borne out in table 5.

TABLE 3.

CORRELATION OF QUALITY SCORE AND %NITROGEN

%N \ QUALITY SCORE	11.71 12.00	11.41 11.70	11.11 11.40	10.81 11.10	10.51 10.80	10.21 10.50	9.91 10.20	9.61 9.90	9.31 9.60	9.01 9.30	8.71 9.00	8.41 8.70	8.11 8.40	7.81 8.10	7.51 7.80	7.21 7.50	f¹
1.00-1.15		1							1								2
1.16-1.30																	0
1.31-1.45										1							1
1.46-1.60						1											1
1.61-1.75	2			2	2	2	1	1	1								11
1.76-1.90	1	1	1	6	3	2	1	3	2	2		1					23
1.91-2.05	1	1	7	2	4	4	5	8	3	4	6						45
2.06-2.20	1	2	6	5	6	11	4	1	2	2		3	1			1	45
2.21-2.35			1	2	1	5		3	1				1				14
2.36-2.50	1		2	1	1	1			1	2							9
2.51-2.65						1						1					2
f²	6	5	17	18	17	27	11	16	10	11	6	5	2	0	0	1	152

(r=.33±.048)

The relation between starch and nitrogen per cent is shown in table 4. A not too significant coefficient of —.2±.52 gives some negative correlation between high starch content and high nitrogen content.

TABLE 4.

STARCH VERSUS NITROGEN

%STARCH	82258100	79.75 78.50	77.25 76.00	74.75 73.50	72.25 71.00	69.75 68.50	67.25 66.00	64.75 63.50	f'
%N	81.01	79.76 78.51	77.26 76.01	74.76 73.51	72.26 71.01	69.76 68.51	67.26 66.01	64.76 63.51	62.26
100-115		1				1			2
116-130									0
131-145						1			1
146-160					1				1
161-175		1 1	1 1	2 1		3	1		12
176-190			1	3 5	5 2		1 3	1	21
191-205	1	1 2	2 3	3 7	8 5	8 3	1 1	1	1 47
206-220	1		3	3 6	8 6	10 1	2 2	1	43
221-235					2 2	2 7			1 14
236-250		1		2		2 1	1 1	1	9
251-265			1				1		2
f^2	2	3 4	7 5	10 22	24 17	25 16	8 5	2 0	2 152

$(r = .2 \pm .052)$

Table 5 shows that dry matter content follows closely the relation of starch to quality. High dry matter per cent means high starch and mealiness,—good cooking potatoes. Note: These correlations were worked out from the method given in Ill. Bul. 148 by Rietz & Smith.

TABLE 5.

RELATION OF QUALITY SCORE TO STARCH NITROGEN AND DRY MATTER

NO. OF LOTS	SCORE POSSIBLE	SCORE RANGE	SCORE ACTUAL	STARCH	NITROGEN	DRY MATTER
32	12	11-12	11.42	74.36	2.01	22.00
63	12	10-11	10.51	70.00	2.03	21.13
43	12	9-10	9.52	71.32	2.02	20.28
13	12	8-9	8.62	70.34	2.08	19.00

From the manner of obtaining samples in this experiment the writer has not been able to isolate and determine the influence on quality of many growth factors. Healthy tubers were used for seed in all tests with the assumption that diseased plants cannot give good cooking tubers. All fertilizer treatments used seemed to give good yields and quality. No distinctly potash deficient soil was used in any test. Conditions vary so within the same type or on different types of soil that no accurate test could be made of the influence of soil type. The same strains grown on a heavy silty clay type of soil seemed to give about the same quality as when grown on an adjoining gravelly or shaly type. This seems to show that when given proper cultural treatment any type of soil may grow good potatoes.

Table 6 shows the influence of rainfall, temperature and variety on quality. The lower average temperature favors better quality. Rainfall was about the same for high and low quality groups and so cannot be said to have as much influence as temperature. Altitude, of course has an influence on temperature, and so the higher altitude with a lower average temperature shows better quality even though the rainfall is no greater than at the lower altitude.

Variety A was much less influenced by high temperature than variety B. It should be possible then to develop varieties suited to less favorable temperatures either by their shorter length of growing season or some combination of physiological make-up.

Conclusions

A mealy, flaky, white flesh cooked potato is the standard of quality preferred in this country.

The exact degree of quality is rather difficult to measure, but the score card used gave rather consistent differences in quality when taken as the average opinion of several judges. All three quality characteristics are closely related.

The evidence from cooking and chemical tests seems sufficient to conclude that good cooking quality is closely associated with high starch and dry matter content of the tuber, and low nitrogen content.

There probably are a large number of factors which influence potato quality. Some of these are difficult to determine since many growing conditions cannot be controlled. This experiment shows that temperature and variety are the most important factors. Lower temperature, sufficient rainfall, and an adapted variety are essential for best cooking quality tubers if the ordinary cultural factors are properly managed.

TABLE 6—*Relation of rainfall, temperature, altitude and variety to quality score*

	1930		1931		1932		1933	
	High Score Group	Low Score Group	High Score Group	Low Score Group	High Score Group	Low Score Group	High Score Group	Low Score Group
* Rainfall	2.21 in.	2.15 in.	4.55 in.	3.80 in.	2.50 in.	2.97 in.	4.70 in.	5.19 in.
† Temperature	65.8° F	74.0° F	67.8° F	74.7° F	65.5° F	72.5° F	66.4° F	79.4° F
‡ Altitude	2000 ft.	350 ft.	2000 ft.	350 ft.	2000 ft.	350 ft.	2000 ft.	350 ft.
§ Var. A Score	11.10	Too poor for	11.04	10.55	11.45	8.7	10.33	10.42
Var. B	10.76	testing	10.82	7.91	11.15	8.4	10.25	7.4

Average score of state—Var. A. 10.90.
Var. B. 9.70.

* Average monthly inches for July, August and September from two localities.
† Average monthly temperature for July, August and September from two localities.
‡ Average for the two localities used above.
§ Average of boiling and baking scores.

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SECTIONAL NOTES

CONNECTICUT

Wholesale market prices of potatoes in Connecticut ranged from $1.00 to $1.20 per bushel on December 9. Farmers are holding out firmly for these or higher prices.

At present, those in charge of carrying out the provisions of the Potato Control Act in Connecticut are awaiting the necessary forms and final information as to allotments from Washington. (Dec. 9).—B. A. BROWN.

MAINE

Plans are rapidly progressing to carry on the operation of the provisions of the Potato Control Act. A State Committee, consisting of A. J. Beck, E. L. Newdick and Carl Smith have been appointed and A. K. Gardner, Crops Specialist with the Extension Service, has been appointed as the State Potato Agent.

An Aroostook County Committee, which, in areas other than Maine, would serve the same purpose as the State Committee, consists of T. E. York of Mars Hill, Edgar W. Russ of Caribou, P. A. Cyr of Lille, T. E. Houghton of Fort Fairfield, Donald M. Kilpatrick of Presque Isle, Cecil McGinley of Houlton, and Herbert H. Thompson of Limestone.

Frequent meetings are being held to study methods of carrying out the plan of operation and serving the best interests of all growers in the state. This program is, of course, being carried forward under Title 2 of the Control Act.

Under Title 1, a hearing was held on December 6th in preparation for development of a marketing agreement and diversion program, making it possible for lower grades to be kept off the markets, thereby insuring more orderly movement and also higher prices for the better grades.

Some criticism is heard of Maine's allotment, which, taken together with criticism of allotments for other States, indicates that probably they are, as a whole, fair and equitable since some elements in every state are dissatisfied.

Shipments to date, although 5000 cars less than a year ago, probably represent about the same percentage of the crop that was moved last year to the same date. While we are in the midst of the usual December "slump," growers and dealers, and other interests concerned,

are patiently waiting for the turn of the year with the usual increase in shipments and activity.

Shipments of seed run considerably behind last year with little activity at the present time. Indications suggest that buyers are waiting until they actually need their supplies before purchasing, preferring to pay the market price at time of planting rather than speculate earlier. This is probably because of lack of money more than anything else, as it now appears that during the time of shipments the activity will be so great that higher prices are almost certain to result.

Growers and shippers in Maine have not seen, for many years, so heavy a shrink as is the case this year. The operation of the True Branding Law, so-called, passed by the last Legislature, has been very helpful in improving the grades. Splendid progress has been made, and with improvement in enforcement, further progress is possible.

The marketing program of the Aroostook Production Credit Association is proceeding in a constructive manner. In the minds of impractical observers, much of our improved price in Maine has been made possible by the operations of this marketing plan. Criticisms have been frequent—some justified; but the accomplishments will so much outweigh the mistakes that they are small in comparison. All interests are more and more appreciating this marketing program, realizing, as they do, that benefits have accrued to every one connected with the Maine potato industry.

A brief enumeration of some constructive developments might be of interest. First: Cooperative financing at a low rate of interest, made possible through the Production Credit Association unit of the Farm Credit Administration. Second: Enactment of the State True Branding Law which is greatly improving the quality and grades. Third: Enactment of National Legislation making potatoes a basic commodity, thus making possible marketing agreements and limitations of shipment of inferior quality potatoes under a diversion plan, and, also, restriction of sales under national allotments. Fourth: and, perhaps, most important of all, development of orderly and controlled system of marketing, in a co-operative way, in the interests of the producer, through the delivery of potatoes in payment of Production Credit Association advances. This may be most important of all because of it the grower may see that much of the solution of his own problems lies within his own control, and, thereby, realize that "rugged individualism" really means chaos whether in production of potatoes or in any other social and economic field. (Dec. 12).—FRANK W. HUSSEY.

Maine is preparing for the operation of the Potato Control Act. Three meetings have been held and the fourth one is being held today in Presque Isle. The County committees are named and for the most part have definitely organized. Arrangements have been made for office space and as soon as the printed forms arrive from Washington community meetings will be held in each County. It is proposed to have every potato grower sit in at a meeting and fill out his allotment blank. At this time the County Agent or some member of the committee will be present to help interpret the various rules and regulations. Previous to the time of these meetings an explanatory circular will be sent to more than 25,000 farmers from the office of the State Potato Agent.

The greatest difficulty so far has been to get men actively engaged in the industry who can afford to absent themselves from their own work in order to take up the duties of a County committee member. The State Board had its first meeting in Caribou last week. At this particular time Maine's allocation compared with the total allocation for the United States was discussed and it is believed that a representation will be made to the A. A. A.

At a hearing held in Caribou last Friday a marketing agreement for the Counties of Aroostook, Penobscot and Piscataquis in Maine was heard before four representatives from the Administration. Six hundred farmers attended, and it seemed to be the general opinion that Maine would enter into an agreement which would allow for the removal from the trade of lower grade stock. The present price level makes an agreement unnecessary but Maine farmers have only to look back a few weeks to recall the necessity of remedial measures. (Dec. 12).—E. L. NEWDICK.

MASSACHUSETTS

In furtherance of the Potato Control Act, a state committee has been selected and educational meetings have been completed in each county for the appointment of county and town committees. As soon as blanks are available from Washington, further meetings of growers will be held for the filling out of allotment applications.

Variety tests of potatoes conducted the past season confirmed results of previous years in showing Chippewa desirable in type and surpassing, in yield, Green Mountains, Katahdin, Russet Rural, Warba and Golden in the order named.

In a spraying test with Green Mountains, conducted on the College Farm, a comparison was made of a 5-5-50 Bordeaux Mixture and

Basic Copper Sulphate (with Wyo-Jel). These two fungicides were applied at the rate of 200 gallons per acre and 12 applications were made in all. The yield of the unsprayed plot was 180 bushels as compared with 198 and 437 for the Basic Copper Sulphate and Bordeaux Mixture respectively. (Dec. 10).—RALPH W. DONALDSON.

NEW YORK

An administration has been named to take charge of the Potato Control Program in the state, a state committee has been selected, and regional meetings are now being held at which the provisions of the Potato Act are thoroughly explained and the administrative set up is discussed. At these regional meetings county agents and their assistants, the farm bureau potato committees, and other leaders were present. Seven of these regional meetings are being held and these will cover all the counties in the state. Following these regional meetings there will be a county-wide meeting in every agricultural county in the state. The county meetings will be open to every one and will be in the nature of a mass meeting. Most of these will be held during the month of January. The essential provisions of the Act will be explained and instructions will be given with reference to application for allotments and other pertinent information. (Dec. 12).—H. C. THOMPSON.

IOWA

Growers are gradually agreeing to support the Potato Control Act.

We are planning a meeting of northern Iowa and southern Minnesota muck land vegetable growers for January 8 and 9, either in northern Iowa or at Albert Lee, Minnesota, at which the potato act and its enforcement will be featured.

The few who have stored their crop are now getting a living price. This rise in price seems to have been built on facts of ground frost in states along the Canadian border, and not on sentiment. No severe damage has been experienced in Iowa to date. (Dec. 12).—C. L. FITCH.

VERMONT

Administration of the Potato Control Act of 1935 for Vermont has been placed in the hands of Harris W. Soule, County Agent Leader, Extension Service, as Administrator. A State Committee consisting of L. H. Marvin of Essex Junction, H. A. Merrill, Bellows

Falls and E. A. Jones of Waitsfield has been appointed and County Committees will soon be selected. These selections probably will be made from a list of nominations secured at local meetings of potato growers covering the principal growing districts of the state. The first step in making individual allotments will come through the county Committees.

Those who have studied the situation are looking forward with considerable interest to the number of allotments which will be asked for. According to the census there are 27,000 farms in Vermont. Discounting perhaps 7,000 of these as small places or rich men's estates upon which no potatoes for sale are grown, the question arises as to how many of these 20,000 bona fide farms are in the practice of selling potatoes. At present, the answer to this will be no better than a guess. A tentative estimate upon which to start business is 12,000. Whatever results are obtained from the application of the control act we shall have much more accurate information concerning the potato industry in the state after the allotments have been requested and made.

Plans are being made to enlarge and extend the scope of the Seed Potato Growers' Association in order to open the membership to all potato growers whether or not they are engaged in raising certified seed. (Dec. 11).—H. L. BAILEY.

WISCONSIN

It is evident from a survey of conditions in Wisconsin that the damage reported from the severe freeze of October 1 was not overestimated and growers report that supplies of potatoes in the shipping areas are very much reduced. We were very fortunate in Wisconsin, however, that in the main the Irish Cobbler and Triumph varieties were harvested before the freeze and supplies will be available for normal trade channels.

On a recent trip through the state we noted renewed interest in market packages and a limited amount of stock is being put up this year in consumer packages of both the cloth and paper types. (Dec. 14).—J. G. MILWARD.

PROGRAM
OF THE
TWENTY-SECOND ANNUAL MEETING
OF
THE POTATO ASSOCIATION OF AMERICA
December 31, 1935, to January 2, 1936

President, J. R. TUCKER, *Central Experimental Farm, Ottawa, Canada.*
Secretary, WM. H. MARTIN, *Rutgers University, New Brunswick, N. J.*

Tuesday Morning Session, December 31, 10:00 a. m.; Room 201, Municipal Auditorium.

J. R. TUCKER, *Chairman*

1. Appointment of Committees.
2. Address by the President, J. R. TUCKER, Central Experimental Farm, Ottawa, Canada.
3. Report of the Secretary-Treasurer.
4. Report of Research Committees.
Culture and Storage. E. V. HARDENBURG, Cornell University.
Potato Breeding. C. F. CLARK, U. S. Department of Agriculture.
Fertilizer Studies. ORA SMITH, Cornell University.
Virous Diseases. DONALD FOLSOM, University of Maine.
Potato Insects. G. F. MACLEOD, Cornell University.
5. Discussion.
6. *Potato Production Methods in Great Britain.* (20 min.) (Lantern) FRED H. BATEMAN, York, Pennsylvania.

Tuesday Afternoon Joint Session with the American Society for Horticultural Science, December 31, 2:00 p. m.; Room 422, Municipal Auditorium.

1. *The Behavior of a Somatic Mutant of the Warba Potato.* (7 min.) F. A. KRANTZ, University of Minnesota.
2. *A New Potato Variety from British Columbia.* (7 min.) WALTER JONES and H. S. MACLEOD, Laboratory of Plant Pathology, Saanichton, B. C.
Discussion. (6 min.)
3. *Effect of Soil Reaction on Yield and Market Quality of Potatoes.* (7 min.) (Lantern) ORA SMITH, Cornell University.
4. *Maturity and Type of Potatoes as Influenced by the Fertilizer Program.* (10 min.) F. M. HARRINGTON, Montana State College.
5. *Relations of Soil Reactions and Storage to Partial Composition and Cooking Quality of Potatoes.* (10 min.) (Lantern) ORA SMITH, Cornell University.
Discussion. (12 min.)
6. *The Effect of Length of Dormant Period upon the Subsequent Flowering of the Potato Plant.* (10 min.) JULIAN C. MILLER, Louisiana State University.
7. *Non-Legumes, as Green Manures, for Potatoes.* (10 min.) JOHN BUSHNELL, Ohio Agricultural Experiment Station.
8. *Interlacing Potato Leaves as a Protection against Frost.* (10 min.) (Lantern) C. L. FITCH, Iowa State College of Agriculture.
9. *Morphological Response of the Potato to Abrupt Environmental Changes.* (20 min.) (Lantern) H. O. WERNER, University of Nebraska.
Discussion.

Wednesday Morning Session, January 1, 9:30 a. m.; Room 201, Municipal Auditorium.

R. W. Goss, *Chairman*

1. *Report of the Seed Potato Certification Committee.* KARL H. FERNOW, Cornell University.

2. *The Growing of Certified Seed for the Tropical and Sub-Tropical Countries.* JULIAN C. MILLER, Louisiana State University.

3. *Certified Seed Potatoes from the Standpoint of the Southern Buyer.* JULIAN C. MILLER, Louisiana State University.

4. *New Disease Problems Encountered in Certifying Seed Potatoes in* 1935.
Nebraska. R. W. GOSS, University of Nebraska.
Minnesota. A. G. TOLAAS, Department of Agriculture, St. Paul. Minnesota.
Wisconsin. J. G. MILWARD, University of Wisconsin.
Colorado. C. H. METZGAR, Colorado State College.
Washington. CHARLES D. GAINES, Department of Agriculture, Olympia, Washington.

5. General Discussion of Seed Potato Certification Requirements and Methods of Improving the Service.

Wednesday Afternoon Session, January 1, 2:00 p. m.; Room 201, Municipal Auditorium.

F. J. STEVENSON, *Chairman*

1. *Recent Developments in Breeding for Resistance to Virous Diseases.* E. S. SCHULTZ, C. F. CLARK, W. P. RALEIGH, F. J. STEVENSON, U. S. D. A., and REINER BONDE, Maine Agricultural Experiment Station.

2. *Recent Developments in Breeding for Resistance to Late Blight.* F. J. STEVENSON, E. S. SCHULTZ, C. F. CLARK, W. P. RALEIGH and REINER BONDE.

3. *Recent Developments in Breeding for Resistance to Scab.* W. P. RALEIGH and C. F. CLARK, U. S. D. A.

4. *Progress in Selection of Scab-Resistant Breeding Stock.* (10 min.) J. G. LEACH, F. A. KRANTZ and H. M. DARLING, University of Minnesota.

5. *Potato Breeding Methods.* (15 min.) (Lantern) F. A. KRANTZ, University of Minnesota.

6. *Development of Virous Resistant Breeding Stock.* (5 min.) ~~F. A.~~ K~~RANTZ~~, University of Minnesota. Harold Harrison

7. *What Plant Pathologists Can and Should Contribute to a Potato Improvement Program.* J. G. LEACH, Chairman, Committee on Potato Improvement of the American Phytopathological Society.

8. *Progress Made in the Breeding Program in Various States.*
North Dakota. A. F. YEAGER, North Dakota Agricultural College.
Maryland. J. H. BEAUMONT, University of Maryland.
Iowa. A. T. ERWIN, Iowa State College.
Louisiana. J. C. MILLER, Louisiana State University.
Michigan. E. J. WHEELER, Michigan State College.

Thursday Morning Session, January 2, 9:30 a. m.; Room 201, Municipal Auditorium.

J. R. TUCKER, *Chairman*

1. Business Meeting, Report of Committees and Election of Officers.

2. *Potato Marketing in Great Britain. Progress in* 1935. H. BRYAN, National Institute of Agricultural Botany, Ormskirk, Lancanshire, England.

3. *The Potato Marketing Scheme in Canada.* JOHN TUCKER, Central Experimental Farm, Canada.

4. *Potato Production under the Potato Act.* A. E. MERCKER, U. S. Department of Agriculture.

5. *Potato Marketing Agreements.* (5 min.) W. M. CASE, U. S. Department of Agriculture.

6. Discussion.

7. *Problems in the Study of Comparative Culinary Quality of Potatoes.* (10 min.) E. V. HARDENBURG, Cornell University.

8. *Determining the Value of a New Potato Variety.* (10 min.) A. G. TOLAAS, University of Minnesota.

9. *Bordeaux Mixture in Relation to Yields and Growth Rates of Potatoes in Nassau County, Long Island.* WILLIAM DICKISON, Cornell University.

10. *Further Studies on Continuous Cultivation as a Control for Wheat Wireworms.* W. A. RAWLINS, Cornell University.

Thursday Afternoon Joint Session with the American Phytopathological Society, January 2, 2:00 p. m.; Room 419, Municipal Auditorium.

WM. H. MARTIN, *Chairman*

1. *Further Field Experiments on Potato Scab Control in Western New York.* (15 min.) C. F. TAYLOR and F. M. BLODGETT, Cornell University.

2. *The Addition of Mercury Compounds to the Fertilizer Mixture as a Control for Common Scab of the Potato under Long Island Conditions.* (10 min.) H. S. CUNNINGHAM, Long Island Vegetable Research Farm.

3. *Some Principles Underlying the Fungicidal Action of Mercury in Soils.* (15 min.) (Lantern) ROBERT H. DAINES, New Jersey Agricultural Experiment Station.

4. *A Study of the Toxic Action of Trichoderma sp. on A. scabies.* (10 min.) (Lantern) R. H. DAINES and WM. H. MARTIN, New Jersey Agricultural Experiment Station.

5. *Inoculation of Potato Seedlings with the Yellow Dwarf Virus.* (7 min.) E. J. WHEELER, Michigan State College.

6. *Some Insect and Host Relationships of the Potato Yellow Dwarf Virus.* (15 min.) (Lantern) L. M. BLACK, Cornell University.

7. *Resistance of Potato Varieties to Infection by the Veinbanding Virus.* (10 min.) (Lantern) C. L. VINCENT and L. K. JONES, Washington State College.

8. *Acquired Resistance of Potato to Latent Mosaic.* (10 min.) (Lantern) E. S. SCHULTZ and W. P. RALEIGH, United States Department of Agriculture.

9. *Reaction of a Green Mountain Potato Seedling to Composite Infections of Mild and Crinkle Mosaic and Different Types of Latent Mosaic Virus.* (10 min.) (Lantern) E. S. SCHULTZ and W. P. RALEIGH, United States Department of Agriculture.

10. *Fusarium Wilts, Their Differentiation and the Effect of Environment upon Their Occurrence.* (10 min.) R. W. GOSS, University of Nebraska.

11. *Date of Digging and Its Relation to Development of Rhizoctonia on Potato Tubers.* (10 min.) R. R. HURST and S. G. PEPPIN, Laboratory of Plant Pathology, Charlottetown, P. E. I.